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13. ABSTRACT (Maximum 200 Words) In May 1997, during an Engine Summit sponsored by HQ USAF/IL, the question was raised whether USAF engine maintenance policy should be based on On-Condition Maintenance (OCM) or Reliability-Centered Maintenance (RCM). Shortly thereafter, HQ USAF/ILMM asked the AFLMA to develop an Air Force policy/decision process to determine which maintenance concept should the Air Force use for engine maintenance. After an exhaustive preliminary analysis, the AFLMA determined that OCM is a sub-set of RCM. The two are not mutually exclusive, and therefore one cannot choose between the two. Furthermore, Air Force and DoD directives mandate implementation of RCM for engines.	
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EXECUTIVE SUMMARY

BACKGROUND PROBLEM STATEMENT:

In May 1997, during an Engine Summit sponsored by HQ USAF/IL, the question was raised whether USAF engine maintenance policy should be based on On-Condition Maintenance (OCM) or Reliability-Centered Maintenance (RCM). Shortly thereafter, HQ USAF/ILMM asked the AFLMA to develop an Air Force policy/decision process to determine which maintenance concept should the Air Force use for engine maintenance. After an exhaustive preliminary analysis, the AFLMA determined that OCM is a sub-set of RCM. The two are not mutually exclusive, and therefore one cannot choose between the two. Furthermore, Air Force and DoD directives mandate implementation of RCM for engines.

After further coordination with HQ USAF/ILMM, a revised problem statement was developed. The AFLMA will complete a study to identify barriers to effective implementation of RCM and provide recommendations for improving management of RCM for engines.

OBJECTIVES:

1. Define RCM.
2. Summarize development of RCM.
3. Outline requirements of a RCM program.
4. Define impediments to effective implementation of RCM .
5. Provide recommendations for improving management of RCM.

ANALYSIS/RESULTS:

1. Define RCM.

A defined methodology for developing and maintaining maintenance programs that assures the maximum level of safety and reliability designed into equipment is achieved, at the lowest possible cost. (Noland and Heap, 1978)

2. Summarize development of RCM

In 1968, a working group of airline and manufacturer representatives established the Maintenance Steering Group (MSG). The MSG laid out the principles of RCM in a document known as MSG-1. MSG-1 established the decision logic and guidelines for developing the initial preventive maintenance program for the Boeing 747, and identified procedures for modifying the original maintenance program to reflect observed system performance and reliability trends. In 1970, MSG-2 was published as a guide to the development of preventive maintenance programs for all new aircraft. MSG-3, which further refined the RCM process, was completed in 1979 as an update to MSG-2.

3. Outline requirements of a RCM program.

DOD Directive 4151.16 requires the services to develop and use RCM programs. MIL-STDs 1629A and 1843 provide specific guidance for RCM programs.

4. Define impediments to effective implementation of RCM.

Although AF guidance for RCM exists, conflict in procedures and decision logic were found. The management and application of RCM varies from engine to engine as well as location. Although RCM is designed to maximize safety and reliability at minimum cost, the Air Force lacks the means to accurately measure the varied costs associated with sustaining engines

ASSUMPTIONS AND CONSTRAINTS:

Air Force and DoD directives mandate implementation of RCM for aircraft engines.

CONCLUSIONS:

After an exhaustive analysis, the AFLMA determined that OCM is a sub-set of RCM. The two are not mutually exclusive, and therefore one cannot choose between the two.

RECOMMENDATIONS:

- 1. Establish a core Air Force RCM working group made up of representatives from ASC/LP, ASC/SYLP, SA-ALC/LR, SA-ALC/LP, OC-ALC/LP, AFMC/ENPS and AFIT/LSM to:**
 - a. Review, evaluate and update Air Force RCM policy, guidance, and procedures
 - b. Establish initial and recurring training requirements tailored to RCM analysts, program managers, RCM facilitators, and senior managers
 - c. Conduct an annual review of the Air Force's RCM program (OPR: HQ USAF/ILM, OCR: HQ AFMC, SA-ALC/LR, AFIT/LSM)
- 2. Establish and integrate into the Engine Life Management Plan, through individual engine management plan working groups, a permanent RCM working group at each ALC to:**
 - a. Conduct an annual review of each engine's RCM program
 - b. Review utilization of training opportunities by the ALC (OPR: SA-ALC, OC-ALC)
- 3. Evaluate the Naval Air Systems Command RCM program for use as a model for the Air Force RCM program (OPR: SA-ALC/LR, ASC/LP, OCR: HQ USAF/ILM)**
4. Evaluate the feasibility of outsourcing RCM training and/or oversight of the RCM process (OPR: SA-ALC/LR)
5. Evaluate MSG-3 for use in establishing initial scheduled maintenance programs for new engines (OPR: ASC/LP)
6. Establish an activity-based costing system for use in evaluating sustainment costs (OPR: AFMC/LGI, OCR: HQ USAF/LGSY)



**DEPARTMENT OF THE AIR FORCE
AIR FORCE LOGISTICS MANAGEMENT AGENCY**

LETTER REPORT

**Improving Implementation of
Reliability-Centered-Maintenance (RCM)**

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AFLMA PROJECT NUMBER: LM199721700

JANUARY 1999

PROBLEM STATEMENT:

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METHODOLOGY:

1. A detailed literature review was performed of:
 - a) DOD studies and reports (USAF, USN, USA)
 - b) DOD directives, guidance and handbooks (USAF, USN, USA)
 - c) academic research
 - d) The Airline/Manufacturer Maintenance Development Document (MSG-3).
2. Personal in-depth interviews with key personnel within the Air Force aerospace engineering and depot engine management community were conducted.

CONCLUSIONS AND RECOMMENDATIONS:

1. Define RCM.

A **defined methodology** for developing and maintaining maintenance programs that assures the **maximum** level of **safety** and **reliability** designed into equipment is achieved, at the **lowest possible cost**.
(Noland and Heap, 1978)

2. Summarize development of RCM

In 1968, a working group of airline and manufacturer representatives established the Maintenance Steering Group (MSG). The MSG laid out the principles of RCM in a document known as MSG-1. MSG-1 established the decision logic and guidelines for developing the initial preventive maintenance program for the Boeing 747, and identified procedures for modifying the original maintenance program to reflect observed system performance and reliability trends. In 1970, MSG-2 was published as a guide to the development of preventive maintenance programs for all new aircraft. MSG-3, which further refined the RCM process, was completed in 1979 as an update to MSG-2. The guide is noteworthy because:

- Jointly developed in the 1970s by the airline industry, aircraft manufacturers, and FAA
- Counters escalating maintenance costs
- Improves equipment reliability
- Published as the Airline/Manufacturers Maintenance Program Planning Documents

3. Outline requirements of a RCM program.

- **DOD Directive 4151.16** requires the services to develop and use RCM programs.
- **MIL-STDs 1629A and 1843** provide specific guidance for RCM programs.
- **Reliability Centered Maintenance** (Noland and Heap, 1978) sponsored by DUSD to provide services an in-depth RCM information manual.
- **AFI 21-104/AFMCS 1** directs the PPMG to implement and sustain RCM programs.
- **AFMCI 21-103** directs SPD to perform Biannual reviews of RCM programs and to provide an audit trail of all RCM decisions.
- **T. O. 00-20-1, Chapter 7**, lists all major weapon and propulsion systems with established RCM programs.

4. Define impediments to effective implementation of RCM.

- Although AF guidance for RCM exists (or existed), conflicting procedures and decision logic are (were) described.
- The management and application of RCM varies from engine to engine.
- LOG 032, an introduction to Reliability-Centered Maintenance Analysis, is the only course currently offered by the Air Force.
- Downsizing has increased the responsibilities and workload for some program managers, reducing the time available to perform RCM tasks.
- MSG-3 is designed to develop an “initial scheduled maintenance program”.
- Although RCM is designed to maximize safety and reliability at minimum cost, the Air Force lacks the means to accurately measure the varied costs associated with sustaining engines.

Recommendations

1. Establish a core Air Force RCM working group made up of representatives from ASC/LP, ASC/SYLP, SA-ALC/LR, SA-ALC/LP, OC-ALC/LP, AFMC/ENPS and AFIT/LSM to:
 - a. Review, evaluate and update Air Force RCM policy, guidance, and procedures.
 - b. Establish initial and recurring training requirements tailored to RCM analysts, program managers, RCM facilitators, and senior managers.
 - c. Conduct an annual review of the Air Force's RCM program. (OPR: HQ USAF/ILM, OCR: HQ AFMC, SA-ALC/LR, AFIT/LSM)
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